REMARKS

I. Introduction

In response to the Office Action dated September 6, 2007, claims 27-29, 32, 35-40, and 43 have been amended. Claims 27-44 remain in the application. Re-examination and re-consideration of the application, as amended, is requested.

II. Allowable Subject Matter

In paragraph 3, the Office Action indicates that the subject matter of claims 33-34 and 41-42 would be allowable if written in independent form including all of the limitations of the base claim and any intervening claims. The Applicants acknowledge the Office Action's indication of allowable subject matter, but traverse the rejection of claims27-32, 35-39, 43 and 44.

III. Claim Amendments

Applicants' attorney has made amendments to the claims as indicated above. The Applicants are not conceding in this application that those claims are not patentable over the art cited by the Examiner, as the present claim amendments and cancellations are only for clarifying the language of the claims and facilitating expeditious prosecution of the allowable subject matter noted by the examiner. Applicants respectfully reserve the right to pursue these and other claims in one or more continuations and/or divisional patent applications.

IV. The Cited References and the Subject Invention

A. The Miller Reference

U.S. Patent No. 6,535,734, issued March 18, 2003 to Miller et al. disclose a method and apparatus for steering mobile platform beams. The beams are steered in a manner that reduces overall platform payload processing, and therefore payload weight and power requirements. According to the present invention, a beam steering data calculator (64) generates a table of beam steering data sets (60a, 60b), with each data set corresponding to a specific beam-pointing angle mapped to a corresponding cell on the surface of the earth. A data set that corresponds to a received downlink cell address (22a-22e) is read out from the table and mapped to the downlink address, and

an output angle of a modulated vehicle beam (16a-16e) that transmits a data packet to the cell address is corrected to correspond to the beam-pointing angle of the read-out data set. The generated table of beam steering data sets (60a, 60b) is then re-used for an application-specific quantization time for mapping subsequently-received downlink addresses with beam steering data sets, thereby obviating the need to provide real-time updates of data sets on a packet transmit interval basis. In addition, the present invention is capable of compensating for numerous other causes of beam-pointing error, thereby improving overall beam-pointing accuracy.

B. The Patouraux Reference

U.S. Patent No. 6,804,986, issued October 19, 2004 to Patouraux discloses a method and apparatus for determining a calibrated value for the yaw angle of a satellite. The method allows determination of the yaw angle of a satellite from the reading of two different sensors measuring the roll and/or pitch angles, provided that the reference point of the two sensors are not identical. A description is given basically for geostationary satellites but the method can be applied directly to satellites which are stationary with respect to any star. The method can be employed for circular and non-circular orbits.

V. <u>Office Action Prior Art Rejections</u>

In paragraphs (1)-(2), the Office Action rejected claims 27-32, 35-40, and 43-44 under 35 U.S.C. § 103(a) as unpatentable over Miller et al., U.S. Patent No. 6,535,734 (Miller) in view of Patouraux, U.S. Patent No. 6,804,986 (Patouraux).

<u>With Respect to Claims 35-40 and 43</u>: Claim 35 recites:

> *An apparatus for reducing the asymmetry error in a beacon, wherein the beacon comprises of multiple beams, and each beam is formed from a multiplicity of feed channels, comprising:*
> *means for beacon computing asymmetry angles; and*
> *means for using the beacon asymmetry angles to correct the beacon sensor measurements.*

According to the Office Action,

Regarding claim 35, Miller teaches means for computing asymmetry angles (correction for pitch, roll, and yaw angles) and means for using the asymmetry angles to correct the pointing angle using measurements.

The Office Action refers to the following portions of the Miller reference:

Space Vehicle Pitch, Roll and Yaw Compensation

Referring now to FIGS. 5–6, compensation by the beam steering data calculator **64** for pitch, roll and yaw of the vehicle will now be discussed. In generating the above-described data sets, the beam steering data calculator **64** is programmed to utilize an antenna plate mechanical reference vector **74a** (which may or may not coincide with the vehicle velocity vector **74b**) as the reference X axis, and a vector between the antenna and the nadir point **77** as the Z axis, with the Y axis being set as orthogonal to both the X and Z axes. The beam steering data calculator **64** is also programmed with an algorithm that factors in the latitude and longitude of the payload nadir pointing position **77**. From this information the calculator **64** can easily determine the area of the earth covered within the platform's FOV **20**. Furthermore, knowing the application specific method for tiling the earth with the fixed GLAs, the calculator can build a table of all latitude and longitude sets for each GLA in the FOV. The beam steering data calculator uses the following equations to generate compensation data for each beam and cell, such as beam **16e** and cell **22e** in FIG. 5, within the FOV.

Once the beam steering data calculator **64** has generated the desired beam-pointing angle, it compensates for vehicle pitch, roll and yaw by generating a corrected beam steering angle as shown in Eqn. (4).

$$\begin{bmatrix}\hat{x}\\ \hat{y}\\ \hat{z}\end{bmatrix}=\begin{bmatrix}\cos\phi_p\cos\theta_r\cos\psi_y-\sin\phi_p\sin\psi_y & -\sin\phi_p\cos\theta_r\cos\psi_y-\cos\theta_r\sin\psi_y & \sin\theta_r\cos\psi_y\\ \sin\phi_p\sin\psi_y+\cos\phi_p\cos\theta_r\sin\psi_y & -\sin\phi_p\cos\theta_r\sin\psi_y+\cos\phi_p\cos\psi_y & \sin\theta_r\sin\psi_y\\ -\cos\phi_p\sin\theta_r & \sin\theta_r\sin\phi_p & \cos\theta_r\end{bmatrix}\begin{bmatrix}\text{beam}\_\hat{x}\\ \text{beam}\_\hat{y}\\ \text{beam}\_\hat{z}\end{bmatrix} \quad \text{Eqn. (4)}$$

In Eqn. (4), ϕ_p is the pitch angle of the emitter **18**. This is the angle in the vehicle XZ plane between what the vehicle registers as a '0' angle, and the actual (nadir) '0' angle (denoted as the +Z axis in FIG. 5). Further, θ_r is the roll angle of the antenna **18**, or the angle in the vehicle YZ plane between what the satellite registers as a '0' angle, and the actual (nadir) '0' angle (denoted as the +Z axis in FIG. 5A). In addition, ψ_y is the yaw angle of the antenna **18**, or the angle in the vehicle XY plane between the axis of the vehicle

intended to be parallel to the vehicle velocity vector and the actual velocity vector (denoted as the +X axis in FIG. 5A).

After the beam steering data calculator determines the corrected beam-pointing angle, it calculates the nadir and azimuth angles necessary to realize the corrected beam-pointing angle through Eqns. (5) and (6).

$$nadir = \cos^{-1}\frac{\hat{z}}{\sqrt{\hat{x}^2+\hat{y}^2+\hat{z}^2}} \qquad \text{Eqn. (5)}$$

$$azimuth = \tan^{-1}\frac{\hat{y}}{\hat{x}} \qquad \text{Eqn. (6)}$$

As shown in the elevation view in FIG. 6, the nadir and azimuth angles are calculated for each cell within the antenna FOV 20 from Eqns. (5) and (6), and are input to beam steering data tables, such as tables *60a* and *60b*, for beam steering purposes.

However, the foregoing discloses the computation of a beam pointing angle, then compensates for the pitch, yaw, and roll angles of the *satellite*. These are not beacon asymmetry angles.

The Office Action acknowledges that Miller fails to teach a beacon sensor, but indicates that Patouraux discloses a means for computing asymmetry angles (pitch and roll angles) and beacon sensor measurements a follows:

As an example, two sensors used on-board the ASTRA satellites are considered in the following, but different kinds of sensors may be used as well. One sensor is an optical infrared earth sensor assembly (ESA) with the subnadir point N (center of the earth) as its reference point. The other sensor is a beacon sensor with the ground station G as its reference point. Each sensor issues roll and pitch angle attitude errors defining the difference between the direction it points to, its "boresight", and its reference point (identified by points G and N). The satellite transmits the telemetry values of the measured roll and pitch angles of both sensors to the ground station which records them for further processing and/or analysis. The roll and pitch errors of at least one of the sensors are also sent to the on-board processor for roll and pitch control.

It should be noted again that the method explained below extends to any kind of pair of sensors measuring roll and pitch angles or two linear combination of these angles, as long as the reference points G and N of the two sensors are different. In addition, the method can also readily be extended to a point N not being on the center of the earth.

The foregoing discloses beacon sensors and how they can be used to compute roll and pitch attitude errors. These are likewise not beacon asymmetry angles.

The Office Action indicates that it would be obvious to combine Miller and Patouraux in order to provide fast measurements:

> Against this background the technical problem to be solved is to provide a method and an apparatus for determining the yaw angle of a satellite on the basis of sensor measurement signals readily available at the satellite, i.e. without the requirement of additional sensors.
>
> A very advantageous aspect of the invention is the fact that the invention needs no estimation schemes which introduce a considerable delay in computing the yaw angle. Rather the invention makes use of a direct measurement of the yaw angle by means of sensors already present on the satellite. This makes it possible to provide a fast yaw measurement avoiding to collect hours of data before be able to infer a good yaw estimation.

The foregoing simply indicates that satellite sensors are used to compute a yaw angle. It does not provide motivation for the inclusion of a beacon sensor. Further, even if Patouraux provided this teaching, neither Miller nor Patouraux disclose the computation of beacon asymmetry errors or using them to correct beacon sensor measurements.

Claims 36-40 and 43 incorporate the feature of claim 35 and are patentable on the same basis.

With Respect to Claims 27-32 and 44: Claims 27-32 and 44 were rejected on the same basis as claims 35-40. Claims 27-32 and 44 are patentable for the same reasons as claims 35-40 and 43.

VI. Dependent Claims

Dependent claims 38-24 and 26-44 incorporate the limitations of their related independent claims, and are therefore patentable on this basis. In addition, these claims recite novel elements even more remote from the cited references. Accordingly, the Applicants respectfully request that these claims be allowed as well.

VII. Conclusion

In view of the above, it is submitted that this application is now in good order for allowance and such allowance is respectfully solicited. Should the Examiner believe minor matters still remain that can be resolved in a telephone interview, the Examiner is urged to call Applicants' undersigned attorney.

Respectfully submitted,

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